PROPOSED DEMOLITION OF "THE BIRDS" AT 108 HALMERGATE, SPALDING, PE11 2EL AND CONSTRUCTION OF A CARE HOME ON THE SITE.

FLOOD RISK ASSESSMENT



View of site from Halmergate

S M Hemmings B Sc C Eng MICE MIWEM,
40 Celta Road,
Peterborough,
PE2 9JD.

This flood risk assessment has been prepared solely to support the planning application for the development at The Birds, Halmergate, Spalding. The author has made every effort to provide an accurate assessment of the flood risk but accepts no liability should the information be found to be incorrect or incomplete, or if it is used for any purposes other than for which it was originally commissioned.

Introduction.

A planning application is due to be submitted to South Holland District Council to demolish the existing public house called “The Birds” and construct a new care home on the site at 108 Halmergate, Spalding, PE11 2EL.

The site is in Flood Zone 3 as shown on the Environment Agency’s Flood Zone map. The flood zone maps do not take into account existing flood defences.

For the Planning Application to be valid a flood risk assessment needs to be carried out to conform with the requirements of the Technical Guidance to the National Planning Policy Framework Development and Flood Risk. The site is within a defended area as specified in the South Holland District Council’s Strategic Flood Risk Assessment and is located in the South Holland Internal Drainage Board District.

Environment Agency (EA) Flood Zones

The map below is taken from the Environment Agency website and shows the flood zones in the area.



It can be seen that all of the area between the River Welland and the Coronation Channel is within Flood Zone 3 (coloured dark blue).

South Holland District Council Policies

The Council agreed the following relevant policies as part of the South Holland Local Plan in 2006:

Policy SG9 – Development and Flood risk:

In areas of flood risk planning permission will only be granted where a flood risk assessment has been carried out and submitted to the Council. Proposals shall,

where necessary, include details of measures designed to reduce the risk and consequences of flooding.

For permission to be granted the Strategic Flood Risk Assessment and site specific assessment will need to demonstrate how the proposed development will be defended from flooding for its proposed life, taking into account proposed mitigation measures.

Built development that would be at high risk of flooding, or which may be subject to rapid inundation, will not normally be permitted unless exceptionally required for operational reasons.

Application Site

The development site is located in the area between the River Welland and the Coronation Channel. The National Grid Reference of the site is 525810 322900.

The location of the site is shown on the plan at the end of this document.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, a development of a care home is classified as “more vulnerable”.

Table 3 of the Guidance is shown below:

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

As the site is within a defended area the proposed development can be designated to be within Flood Zone 3(a) “High Probability” as detailed on the Environment Agency’s flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

Therefore it can be seen that for “More vulnerable” development the sequential and the exception tests need to be applied to the development.

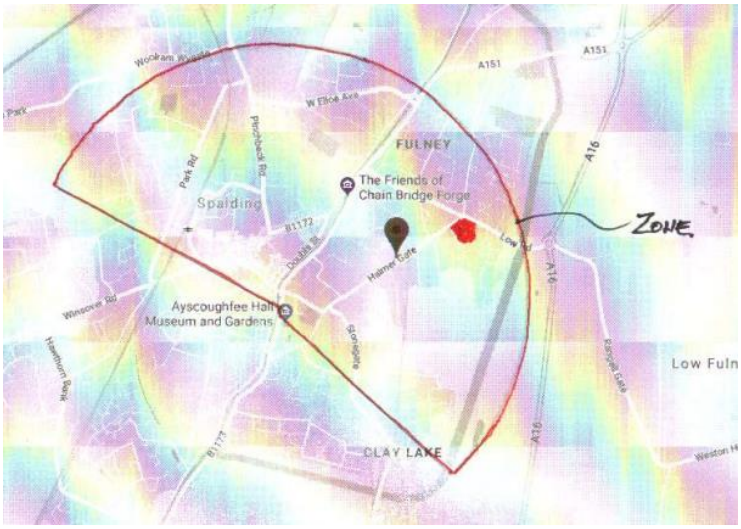
Sequential Test

The aim of the Sequential Test, as set out in the Planning Practice Guidance, is to ensure that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones as defined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local

planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

All of the area between the River Welland and the Coronation Channel, as can be seen from the map on page 2 of this report, is in Flood Zone 3. Therefore it would be difficult to find a similar site for development in this area of Spalding that is in a lower flood zone.

The Care Home provider has indicated that there is a shortage of care home accommodation in the area shown on the map below:



All of the area of Spalding shown on the map above is within flood zone 3.

Therefore it is only viable to locate the development in flood zone 3 in this area of Spalding where there is a lack of this type of accommodation.

The safety of the development will be delivered by ensuring the floor level of the proposed new dwellings is above the predicted residual flood levels for this area.

The South Holland District Council Core Strategy states that there is a shortage of care home accommodation in the central area of Spalding. The Council encourages development of brownfield land inside the town boundary for this type of accommodation.

Therefore I consider that the sequential test has been passed.

Exception Test

The Sequential Test has demonstrated that it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding. Therefore the Exception Test must be applied and for this to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risks, informed by the Strategic Flood Risk Assessment; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking into account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.

Both parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

The first section will be demonstrated by the Supporting Planning Statement and compliance with South Holland District Council's planning policies.

This flood risk assessment will demonstrate that the development will be safe for its lifetime and it will not increase flood risk elsewhere.

South Holland DC Strategic Flood Risk Assessment (2010)

Consultants produced a Strategic Flood Risk Assessment (SFRA) in 2010, which has recently been updated, for the South Holland District Council (SHDC). This document provides details of the flood risk in the Council's area. Reference to the maps in this document give the following information for the flood risk and hazard at the site for the 1% fluvial event and 0.5% tidal event.

The maps illustrate the actual flood hazard which is as follows:

For the present day	Depth of flooding … zero
	Extent of flooding .. zero
	Hazard …. Nil
	Velocity … Nil
For year 2115	Depth of flooding … 500mm – 1.0 metre
	Extent of flooding …high
	Hazard … Significant
	Velocity .. 0 – 0.1 m/sec

The maps showing the residual flood hazard were revised in the 2016 update of the South Holland District Council Strategic Flood Risk Assessment which can be found on the website of the South East Lincolnshire Joint Planning Committee. The hazards are as follows for the 1% fluvial or 0.5% tidal event probability:

For the present day	Depth of flooding ... 1.0 - 2.0 metres
	Extent of flooding .. High probability
	Hazard … Greater than 2.0 (danger for all)
	Velocity .. 0 – 0.3m/sec

For the year 2115	Depth of flooding.....	Greater than 2.0 metres
	Extent of flooding ..	High probability
	Hazard …	Greater than 2.0 (danger for all)
	Velocity ..	0 – 0.3m/sec

The hazards are as follows for the 0.1% fluvial or tidal event probability:

For the year 2115	Depth of flooding.....	Greater than 2.0 metres
	Extent of flooding ..	High probability
	Hazard …	Greater than 2.0 (danger for all)
	Velocity ..	0 - 0.3m/sec

Figure 16 of the general maps shows that the site is not within the rapid inundation zone for the present day or in 2115.

1. **Maximum flood levels:**
   Maximum flood levels in the River Welland and the Coronation Channel are shown in the reports as follows:

	Present	Present + Climate Change
1 in 100 year	4.32	4.69
1 in 1,000 year	4.34	4.69

- The minimum freeboard on the west bank of the Coronation Channel is 600mm.
- The maintenance standards of these banks are good and defences are well maintained and regularly inspected.

2. **Extreme tide levels**
   The extreme tide levels in the section of the Coronation Channel and River Welland between Fulney Lock and Marsh Road Sluice are shown in the report as follows:

	2007	2055	2115
1 in 200 year	5.98	6.31	7.12
1 in 1,000 year	6.32	6.65	7.46

The lowest bank level on the left bank of the Coronation Channel is 6.88m OD.

The lowest bank level on the right bank of the tidal River Welland is 7.57m OD.

Existing Flood Alleviation Measures

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains" and is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding due to overtopping or failures of the defences is considered to be very low.

The site is approximately 1.2km south of the tidal section of the River Welland, which is the main river and maintained by the Environment Agency.

The site is approximately 600 metres east of the fluvial section of the River Welland, which is the main river and maintained by the Environment Agency.

The site is approximately 250 metres west of the fluvial section of the Coronation Channel, which is the main river and maintained by the Environment Agency.

The area between the River Welland and the Coronation Channel is drained by surface water sewers maintained by Anglian Water, which discharge either into the River Welland or into drainage channels maintained by South Holland Internal Drainage Board. The water levels in the IDB channels are controlled by Clay Lake Pumping Station, which is operated by South Holland IDB, and discharges into the Coronation channel.

Existing Ground Levels

The level of the front car park in front of the existing public house is 3.25m OD, and the average level of the areas to the rear of the public house are the same. The floor level of the existing building is 3.80m OD.

The level of Halmergate near the roundabout in front of the public house is 3.67m OD and Halmergate is lower to the south west is 3.47m OD and Low Road to the east is lower with a level of 3.14m OD.

A full topographical study has been carried out and the drawing will be submitted with the planning application. A sample of these levels have been replotted on a plan which is shown on page 16 of this report.

Potential Sources of Flooding

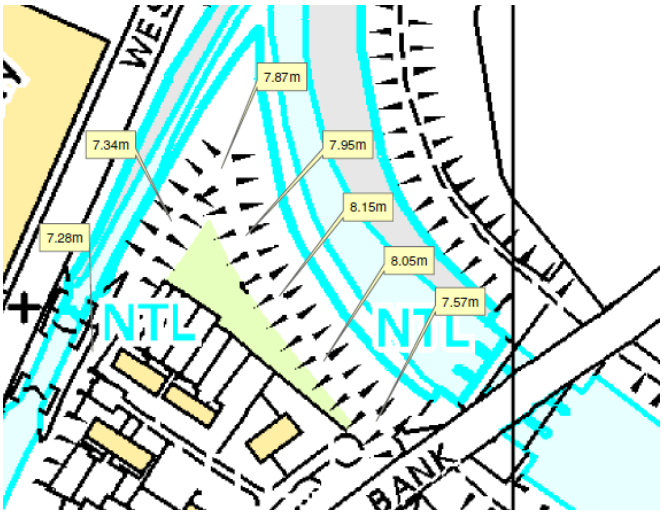
The following sources of flooding have been identified:

1. Failure or overtopping of the tidal defences.
2. Overtopping of the River Welland.
3. Overtopping or breaching of the Coronation Channel.
4. Failures of Clay Lake Pumping Station (IDB)
5. Blockages in Exeter Drain (IDB)
6. Blockages in local surface water sewers (highway or Anglian Water)

1. Failure or overtopping of tidal defences.

There is a short length of tidal defences on the Coronation Channel west of Marsh Road Sluice and on the River Welland north of Fulney Lock that defends the area between the River Welland and the Coronation Channel from tidal flooding. The SFRA states that the defences are adequate to withstand a 1 in 200 year (0.5%) probability event for present day but in the future (2115) some of the banks could be overtopped in a 0.5% probability event.

Crest levels of this bank have been surveyed and these are shown below. These levels range from 7.28m OD near Fulney Lock to above 8.00m OD on the main section of bank. The low level of 6.88m OD mentioned in the SFRA was not found. All the surveyed levels are higher than the 1 in 200 year extreme tide level in 2115 of 7.12m OD stated in the SFRA.



These banks are well maintained and have a top width of at least 4.0 metres, and it is reasonable to assume that during the next one hundred years, considering the assets that are protected by this bank, further maintenance and capital works will be carried out on the tidal banks to ensure a continuing minimum defence standard of 1 in 200 years.

If a breach occurred in the tidal bank during a 1 in 200 year event in the year 2115 flood water would flow southwards and start to flood the whole area between the Coronation Channel and the River Welland. The hazards of this will be considered later in the report.

2. Overtopping of the River Welland.

The crest level of the east bank of the River Welland is approximately 5.50m OD west of the development site. The highest predicted fluvial level for a 1 in 100 year event in the fluvial River Welland in 2115 is 4.69m OD. The level of the east bank of the River Welland varies between 4.90 and 5.30m OD through the town of Spalding.

Therefore there is a risk of flooding to the proposed site from this source if a breach occurred in the east bank of the River Welland in a 1 in 100 year event in 2115.

There is a road located on most of the length of the eastern bank of the River Welland. The gradient of the back face of the bank is less than 1 in 100 as the levels gradually decrease the further east one travels. Therefore the risk of failure of this bank can be considered to be extremely low and this source of flooding can almost be discounted.

3. Overtopping or Breaching of the Coronation Channel

The area between the River Welland and the Coronation Channel is protected from flooding by banks on the west side of the channel, which are approximately 2.0m to

3.0m above the land. The top level of these banks are between 5.40m OD and 6.00m OD, which gives a freeboard of at least 700 mm above the 1 in 1,000 year maximum design level in the channel.

If a breach occurred in the channel the maximum water level in the flooded area could reach between 4.0 m and 4.1 m OD for the present day situation and between 4.3m and 4.4 m OD if climate change is allowed for.

Therefore the risk of flooding from this source can be considered low, and the flood level following a breach would be lower than if the tidal defences were to breach.

4. Failure of Clay Lake Pumping Station

The South Holland IDB estimate that the Clay Lake Pumping Station provides a 1 in 50 year standard with a freeboard, which in effect provides a 1 in 100 year protection against flooding. The pumping station is maintained in good condition and should a failure occur the Drainage Board would quickly deploy temporary pumps to alleviate the situation.

Therefore flooding from this source can be considered to be adequately mitigated because finished floor levels of the proposed development will be significantly raised above the existing ground level.

5. Blockages in Exeter Drain

Exeter Drain is maintained by South Holland IDB and is located 280 metres west of the site of the proposed development. The IDB also maintains the watercourse behind the western bank of the Coronation Channel. Both watercourses flow southwards to Clay Lake Pumping Station. The South Holland IDB has a regular annual maintenance programme which includes the removal of weed growth from channels twice each year. However, any flooding from this channel will not cause any flooding to the proposed building, as explained in (4) above.

Therefore flooding from this source can be considered to be adequately mitigated.

6. Blockages in local surface water sewers

Both Anglian Water and the Highways Authority maintain surface water drainage systems in this area. These will discharge into the IDB drainage system. The floor level of the proposed habitable development will be raised a significant height above the existing ground levels which will provide adequate mitigation against flooding from this source.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties having been flooded in the last 50 years.

Probabilities and Trends of Flooding

The probability of this development being flooded from Environment Agency main river is very low. In an extreme tidal the site would be affected by flood water and this could be approximately 2.0 metres deep.

Climate Change

The recommendations for flood depths for this flood risk assessment use information mostly taken from the South Holland DC SFRA which was last updated in 2010. The EA have issued new guidance on recommended contingency allowances for predicted sea rises, fluvial flows and rainfall intensities which from 19th February 2016 needs to be considered in this FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 17 to 20). Updated SFRA maps were issued on the South East Lincolnshire Local Plan website in March 2017. The modelling and mapping note advises that the new maps do not take into account of the new climate change guidance (February 2016) issued by the Environment Agency. The notes in Appendix A conclude that no extra mitigation measures are necessary to comply with the new guidance on climate change.

South East Lincs Advice Matrix

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website.

As the development is in flood zone 3 and the flood hazard is "Danger for All" (Greater than 2.0) reference should be made to Category C8 which states for a predicted flood depth of greater than 1.6 metres:

It is unlikely that mitigation measures would prevent flood water from entering the building at ground level. Therefore, proposals must have a minimum of 2 storeys with no ground floor habitable accommodation. The first floor living accommodation must be above the highest predicted flood depth.

The conclusions set out below will consider the ground levels on the site and additional information from previous FRA's carried out in this area and this will enable a more accurate assessment of the flood level to be made, and a recommended level for the finished floor level of the building.

Map of Residual Risk

The updated SFRA has calculated the consequences arising from a possible breach occurring at any point along the raised defences. Also considered were scenarios in which gates or other assets fail to operate allowing water to flow inland and cause flooding.

Updated maps showing predicted flood depths were issued on the South East Lincolnshire Local Plan website in March 2017. An extract of the map showing predicted residual flood depths for the 0.5% tidal and 1% fluvial event probability on the development site is shown on the next page.



The map shows the predicted flood depth on the site is greater than 2.0 metres in a 1 in 200 year tidal event in 2115.

Part of the map in the updated SFRA showing the predicted residual depths of flooding in a 1 in 1000 year event in 2115 is shown below.



The map also shows the predicted flood depth on the site is greater than 2.0 metres in a 1 in 1000 year tidal event in 2115.

Comparison of Predictions of Flood Level

There is conflicting evidence about the maximum predicted flood level in the area if a breach occurred in the tidal bank of the River Welland or the Coronation Channel between Fulney Lock and Marsh Road Sluice. The three evidence bases that will be considered in this section of the report are:-

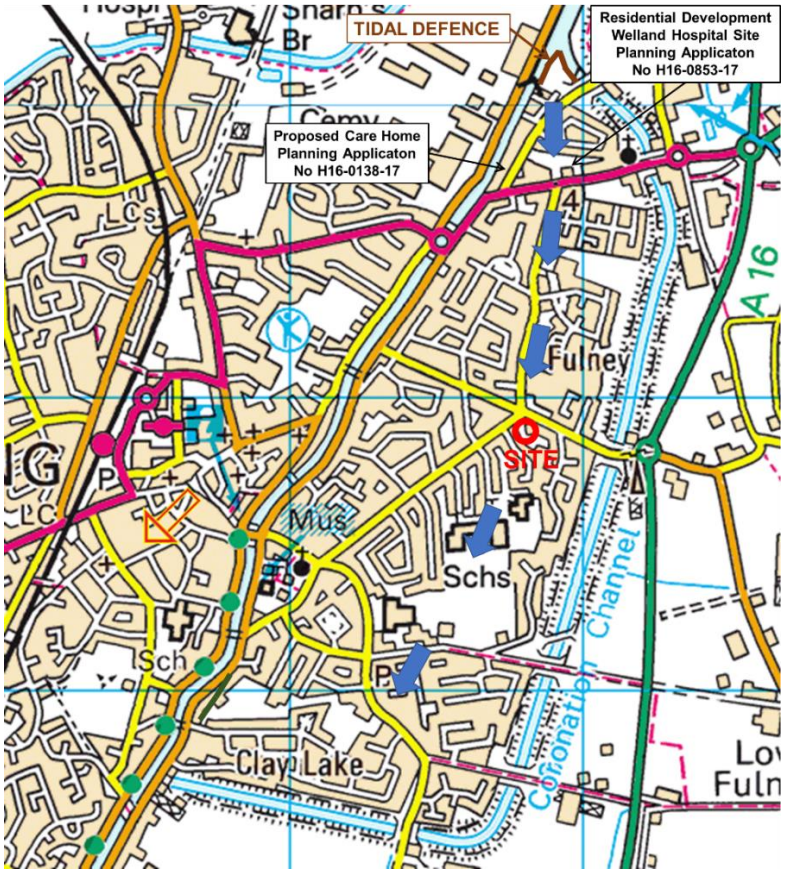
1) The flood depth maps in the updated SFRA.
2) The levels of the banks of the River Welland and the Coronation Channel.
3) Finished floor levels approved in previous planning applications.

1) Flood Depths in the Updated SFRA:

The updated map in the SFRA is shown above, and predicts a minimum peak depth of 2.0 metres at the location of the site in a 1 in 200 year event in 2115. Although the average ground level on the site is 3.25m OD the road level north of the site is 3.60m OD. This gives a minimum predicted flood level in a 1 in 200 year event in 2115 of 5.60m OD.

2) Bank Levels in the River Welland and Coronation Channel:

If a breach occurred in the tidal bank of the River Welland or the Coronation Channel between Fulney Lock and Marsh Road Sluice water would flow into the area between the River Welland and the Coronation Channel. It would flow southwards as shown in the plan below.



The east bank of the River Welland is not raised along any of the length through Spalding. Reference to the bank levels in the SFRA indicates there are 7 locations where the crest level is 4.90m OD and a further 7 locations where the crest level is between 4.90m and 5.20m OD. As these levels are tabulated at 100 metre centres it follows that there is approximately 700 metres of bank at 4.90m OD and a further 700metres with levels between 4.90m and 5.20m OD.

Therefore if the flood level in the area increases above 4.90m OD flood water would start to flow into the fluvial section of the River Welland. If the level increased further additional water would flow into the River Welland.

It is possible that the water level could reach a level of 5.20m OD, but it is unlikely to rise above this level as flood water would start to flood over the banks into the

Coronation Channel and also over the east bank of the Coronation Channel flooding land to the east of this area. This would reduce the risk of levels increasing further in this area.

3) Finished floor levels approved in previous planning applications:

a) Residential Development at Holbeach Road (Application No H16-0853-17).

This is within this same area which is susceptible to tidal flooding from the River Welland between Fulney Lock and Marsh Road Sluice. The letter from the Environment Agency to SHDC dated 29th September 2017 agreed to the proposed dwellings subject to the following conditions:

- FFL should be no lower than 5.00m OD.
- All dwellings should be two storey construction.
- Demountable defences should be provided up to a level of 600mm above finished floor level.

b) Development of a Care Home at Roman Bank (Application No H16-0138-17)

The Environment Agency were consulted on the application, and advised the Council in a letter dated 9th March 2017 (Reference AN/2016/124433/03-L01) this development will only meet the requirements of the National Planning Policy Framework (NPPF) if the following measures are implemented:

1) Finished floor levels are set no lower than 5.20m OD
2) Further flood resilient construction is built into the design.

This application was approved by the Council on 8th September 2017 with the above conditions.

Conclusions

The proposed development is not in a functional flood plain as defined by PPS 25.

Although the site is in flood zone 3(a), the actual risk of the site flooding from any Environment Agency water course is low.

There is no actual risk of flooding at the present time in a 1 in 200 year event.

There is an actual risk of flooding in 2115 in a 1 in 200 year tidal event. You would also expect that the Environment Agency will increase the levels of these tidal defences sometime in the next 100 years, considering how many properties are protected by the tidal defences.

The SFRA states there is a residual risk that the site could flood if a breach occurs in the tidal defences. Although the risk of a breach occurring is very low, it can be shown that if a breach 50 metres wide and 3.0 metres deep is assumed to form within minutes, then water levels in the area between the River Welland and the Coronation Channel could eventually reach in excess of 5.00m OD.

If a breach occurred then the whole area between the Coronation Channel and the River Welland would start to fill with flood water. A major emergency would be called by the Authorities as there would be hundreds of houses at risk.

A very basic design of the flow through a breach and then southwards to the lower parts of the area shows initially flood depths could be nearly 1.0 metre in depth soon after the breach developed. The depth would slowly increase over a few hours until the whole of the area between the River Welland and the Coronation Channel reached 4.70m OD. when it would rise until it reached above 4.90m OD when the flood water would start to flow into the fluvial section of the River Welland. This would limit the further increase in level of flood water. At the same time the level of the tide would be falling and the inflow of flood water would stop for around 6 hours until the next tide.

Considering the above and the comparisons of the predictions for the maximum flood level at the development site it is considered that if the floor level is raised to a level of 5.20m OD this provides adequate mitigation to flooding of the proposed property.

Hovever it must always be remembered that in a flood risk area there is always a risk of an event occurring of greater magnitude than has been considered in this flood risk assessment.

Recommendations

The finished ground floor level of the proposed building should be raised to a minimum level of 5.20m OD which is approximately 1.95 metres above the existing ground level.

Demountable defences should be installed to every external doorway to protect the building up to a depth of 600mm above finished floor level.

Flood resilient construction should be included to a height of 300mm above the predicted flood depth.

The developer should register with the Environment Agency's Floodline Warnings Direct Service and a plan should be drawn up detailing what actions the staff should take if a warning of predicted very high tide levels is received.

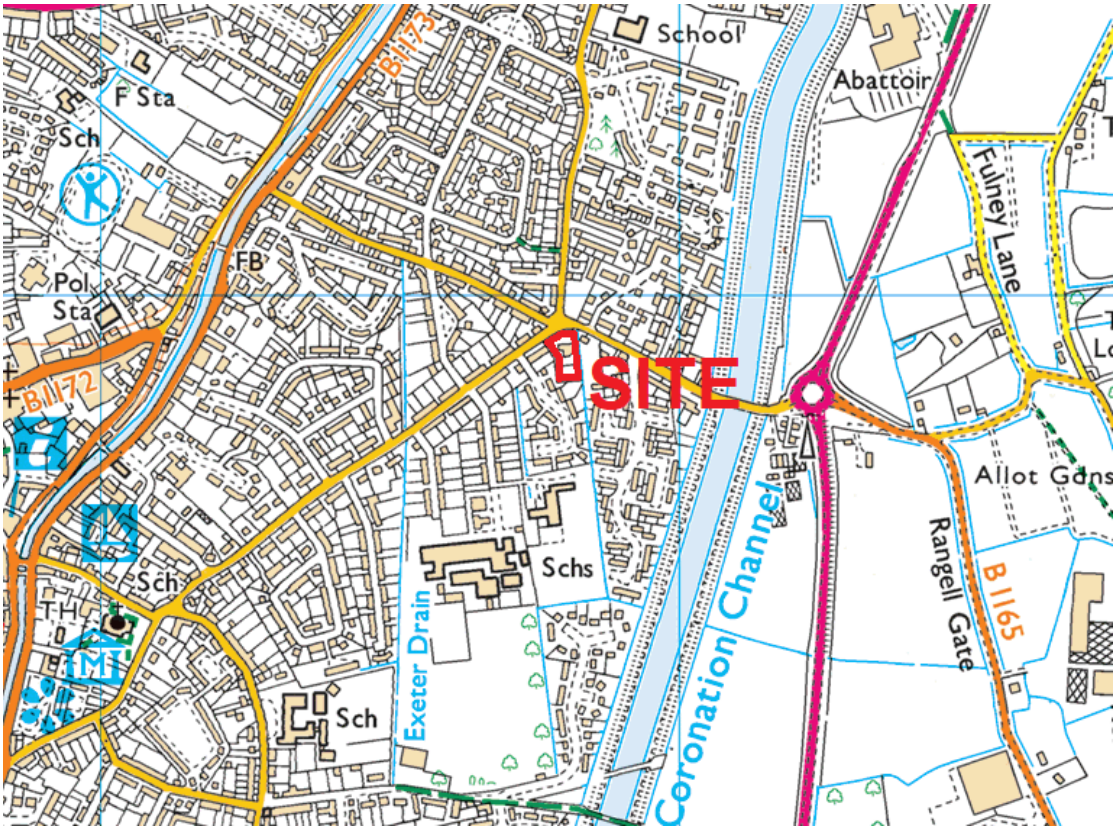
The surface water from the roofs of the proposed building should if possible be discharged into soakaways. These should be designed to comply with the recommendations of BRE 365 and approved under the Building Regulations.

S M HEMMINGS B Sc C Eng MICE MIWEM

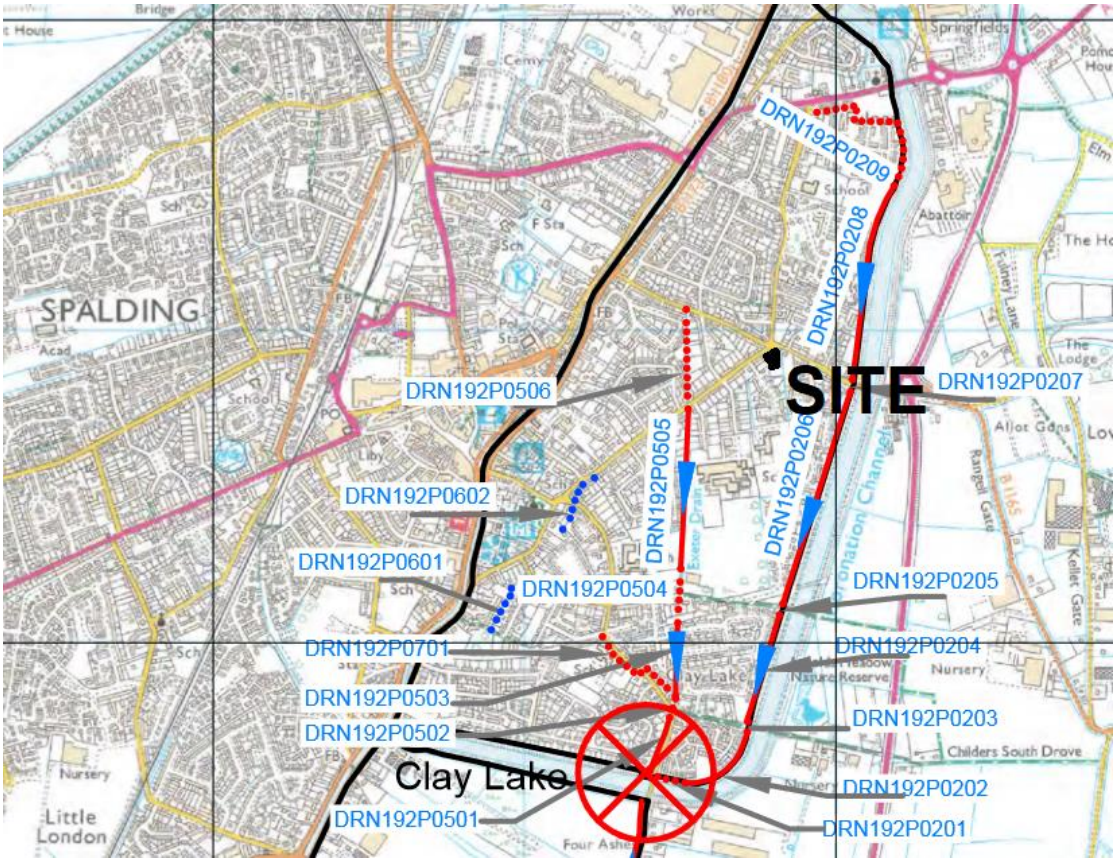
stuart.hemmings@btinternet.com

26th November 2018

LOCATION PLAN



PLAN OF IDB DRAINS



PLAN SHOWING EXISTING SITE LEVELS



APPENDIX A CLIMATE CHANGE

The Environment Agency has issued revised guidance on climate change and have now stated that the new predictions should be considered and incorporated into all flood risk assessments produced after 19th February 2016.

Listed below are the climate change allowances in three documents:

- South Holland SFRA
- EA guidance (2013)
- Revised EA guidance

The recommendations in each document are shown below.

2010 South Holland DC SFRA

The SHDC SFRA states that the the following allowances have been made for climate change:

4.4 Climate Change

Scenarios for the years 2055 and 2115 include for climate change contingency allowances to the amount suggested by PPS25[1]. These allowances are expressed in *Table 2*. Percentage increases are relative to the present-day.

Table 2 – Adopted Climate change contingency allowances

Parameter	Year 2055	Year 2115
Sea level rise (m)	+ 0.33	+ 1.14
Extreme wave height	+ 10%	+ 10%
Peak river flow and volume	+ 20%	+ 20%
Peak rainfall intensity	+ 20%	+30%

Where flows arise from pumping rather than natural run-off, notably in the Vernatt's Drain and for the Fenland subcatchments of the South Forty Foot Drain, peak flow rates for future eras have been taken as equal to current rates since this SFRA assumes all flood risk management measures will remain in their current state.

2013 Guidance to Planners

Guidance to planners was issued by EA in September 2013

Table 1: Recommended contingency allowances for net sea level rises (Net sea level rise (mm per year) relative to 1990)

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

document is out of date e.g.

Table 2: Recommended national precautionary sensitivity ranges for peak rainfall intensity, peak river flow, offshore wind speed and wave height

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

s been withdrawn (19

Revised 2016 EA Guidance

Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

For more vulnerable development in flood zone 3(a) the higher central and upper end should be used to assess the range of allowances.

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Table 3 sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area of England	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative rise 1990 to 2115 / metres (m)
East, east midlands, London, south east	4 (140 mm)	8.5 (212.5 mm)	12 (360 mm)	15 (525 mm)	1.24 m

Table 4 offshore wind speed and extreme wave height allowance (use 1990 baseline)

Applies around all the English coast	1990 to 2050	2051 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitivity test	+10%	+10%

Effects on Predictions of Flood Risk in FRA

The FRA has identified two sources of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site:

1) Flooding from the tidal River Welland
2) Flooding from the fluvial section of the River Welland, the Coronation Channel or IDB drainage system

1) Flooding from the tidal River Welland

The contingency allowance in metres for the years 2055 and 2115 using 1990 as a baseline in the SFRA compared with the guidelines is as follows

Year	SFRA	2013 guidance	Revised 2016 guidance
2055	0.33	0.395	0.412
2115	1.14	1.205	1.24

Therefore it can be seen that the revised guidance increases the maximum allowance for sea rise in 2115 by 100mm. This may slightly increase the risk of a breach

occurring in the tidal bank north of the site. It may also slightly increase the flow of water into the area between the Coronation Channel and the River Welland. However it will not change the conclusions and recommendations in this report.

Fluvial Flooding.

As the development is in flood zone 3 and is classed as more vulnerable, the advice from the Environment Agency is that the higher central climate change allowance, which is 35%, should be considered. After considering the effects of this increase the upper end allowance, which is 65%, should be considered to assess the effect of this.

Maximum flood levels in the River Welland and the Coronation Channel will not be increased by the increase in flows projected in the new climate change allowances. If flows increase by 65% in these systems it will have the effect of flooding over the long sections of bank between Spalding and Market Deeping and the maximum levels in Spalding will not increase significantly.

IDB's have been using an allowance of 20% for climate change over the past few years in their assessments and modelling of their systems. Generally IDB's are happy that their systems provide a 1 in 100 year standard to most urban areas at the present time.

South Holland IDB, and all IDB's, are aware that climate change will affect the operations of pumping stations, sluices and drainage channels. Pumping stations and sluices only have a 30 year life and will need to be refurbished or rebuilt within this timespan. It is assumed that South Holland IDB will continue to review the modelling they have already carried out and when the Board consider these refurbishments adequate arrangements will be made to incorporate the latest climate change projections in order that the Board continues to provide the same standard of service as the present day.

As the major flood risk to the site in Halmergate is from tidal flooding then any increases in flow from fluvial sources or predicted fluvial flood levels will always be less than the risk from tidal flooding.

Therefore it is considered that the mitigation proposed for the development, with the conclusion that the proposed finished ground floor level of the two proposed storey building should be 5.20m OD is satisfactory.